

Name: _____ Date: _____

Answer Key: Secrets of the Carbon Skeleton: A 10th Grade Chemistry Investigation

Analyze molecular geometry, functional group reactivity, and IUPAC nomenclature through application-based organic chemistry problems.

1. A student identifies a molecule with the formula C₅H₁₂. Which structural characteristic most likely accounts for this molecule having a lower boiling point than its straight-chain isomer, n-pentane?

Answer: C) Molecular branching reducing intermolecular contact

Branching (like in neopentane) makes the molecule more spherical, reducing the surface area available for intermolecular London dispersion forces compared to straight chains.

2. In a saturated hydrocarbon chain, every carbon atom is bonded to the maximum possible number of hydrogen atoms through single bonds.

Answer: A) True

Saturation in organic chemistry refers to the absence of double or triple bonds, meaning the carbon skeleton is 'saturated' with hydrogen atoms.

3. The sharp, distinctive aroma of an orange is largely due to Limonene. Limonene is classified as a _____ because it contains only carbon and hydrogen with at least one double bond.

Answer: B) Alkene

Alkenes are unsaturated hydrocarbons containing at least one carbon-to-carbon double bond, which characterizes molecules like limonene.

4. Which functional group is most likely responsible for the pleasant, fruity scent found in synthetic flavorings like pear or pineapple oil?

Answer: C) Ester group (-COOR)

Esters are chemical compounds derived from an acid in which at least one -OH group is replaced by an -O-alkyl group; they are famous for their sweet, fruity odors.

5. Aromatic compounds, such as naphthalene (mothballs), are defined by stable ring structures that follow Hückel's rule for electron delocalization.

Name: _____ Date: _____

Answer: A) True

Aromaticity refers to cyclic, planar molecules with resonant pi-electron systems that provide extra chemical stability.

6. When an organic chemist converts vegetable oil into margarine, they perform a/an ____ reaction to turn liquid unsaturated fats into solid saturated fats.

Answer: A) Hydrogenation

Hydrogenation is a type of addition reaction where hydrogen atoms are added across double bonds, increasing the degree of saturation.

7. Formaldehyde (CH₂O) is the simplest aldehyde. In the Lewis structure of an aldehyde, the oxygen atom is always double-bonded to:

Answer: B) A terminal carbon atom

Aldehydes feature a carbonyl group (C=O) bonded to at least one hydrogen atom, which by definition must occur at the end of a carbon chain.

8. In organic chemistry, isomers are molecules that have the same physical properties but different chemical formulas.

Answer: B) False

Isomers have the *same* chemical formula but *different* structural arrangements, which usually leads to different physical and chemical properties.

9. Which of the following organic compounds is used as the primary building block for the polymer 'polyethylene' found in plastic grocery bags?

Answer: B) Ethene

Ethene (ethylene) molecules undergo polymerization reactions to form long chains called polyethylene, a cornerstone of the modern plastics industry.

10. Functional groups like the -OH group or the -COOH group increase a molecule's ____ in water because they allow for hydrogen bonding.

Answer: C) Solubility

The polar nature of hydroxyl and carboxyl groups allows these molecules to interact with water molecules through hydrogen bonding, increasing their ability to dissolve.

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